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Report of Proceedings

THIRD CONFERENCE ON MAPLE PRODUCTS

October 29 and 30, 1956

Conference was held at the Eastern Utilization Research Branch with representatives of industry and government from the United States and Canada participating. The Agricultural Experiment Stations, the Extension Service, universities, maple producers, processors and distributors, equipment manufacturers, state governments, the United States Military Services and the U. S. Department of Agriculture were represented.

This report summarizes the discussions of the various speakers during the conference. If further details regarding any particular subject are desired, they may be obtained by communicating with the person concerned (see appended list of names and addresses).

Eastern Utilization Research Branch
Agricultural Research Service
U. S. Department of Agriculture
Philadelphia 18, Pennsylvania

PROGRAM

Monday, October 29

9:30 a.m. Welcome and Objectives of the Conference — P. A. Wells, Chief, Eastern Utilization Research Branch

INDUSTRIAL TRENDS

9:45 a.m.

1. The outlook for Vermont's Maple Industry and the Effects of Vermont's Laws Regulating Retail Sales of Maple Sirup — Fortis H. Abbott, Chairman, Vermont Maple Industry Council, Burlington, Vermont

10:30 a.m.

2. The Canadian Maple Sirup Situation — Georges Vallières, Chief, Laboratory of Maple and Honey Products, Department of Agriculture, Quebec, Canada

11:15 a.m.

3. Ohio's Maple Festival and Its Effect on Ohio's Maple Industry — Ture L. Johnson, State Forester, Burton, Ohio

12:00 Noon

4. Report of Proceedings of the Forest Research Advisory Committee — P. Dewey Lyman, White River Junction, Vermont, Member of Forest Research Advisory Committee

12:30 p.m. LUNCH

2:00 p.m.

5. Economic Trends in Maple Sirup - Production and Sales — Edward R. Boylan, President, Cary Maple Sugar Company, Inc., St. Johnsbury, Vermont

2:45 p.m.

6. Agricultural Extension Assistance in Maple Sirup Production — Fred B. Trenk, Extension Forester, University of Wisconsin, Madison, Wisconsin

SIRUP PROCESSING EQUIPMENT

3:30 p.m.

7. Maple Sirup Evaporators, Old and New — Alton E. Lynde, Manager, Leader Evaporator Company, Burlington, Vermont

Monday, October 29 (Continued)

4:15 p.m.

8.	An Analysis of the Open Pan Evaporator	E. O. Strolle, Chemical Engineer Eastern Utilization Research Branch

Tuesday, October 30

9:00 a.m.

9.	A New Rapid Evaporator for Making High Grade Maple Sirup	R. K. Eskew, Head Engineering and Development Section Eastern Utilization Research Branch

RESEARCH PROBLEMS

9:30 a.m.

10.	Some Considerations on Research for the Improvement of the Analysis of Maple Products	Marcel Jean, Professor of Biochemistry Laval University Quebec, Canada

10:15 a.m.

11.	Some Observations on Factors Affecting the Production of Maple Sap	Fred H. Taylor, Professor of Botany University of Vermont Burlington, Vermont

11:00 a.m.

12.	The Production of High Quality Sap and Sirup	Putnam W. Robbins, Professor of Forestry Michigan State University East Lansing, Michigan

11:45 a.m.

13.	The Microbial Contamination of the Tap Hole	Jack M. Sheneman and Ralph N. Costilow Department of Microbiology and Public Health Michigan State University East Lansing, Michigan

12:30 p.m. LUNCH

2:00 p.m.

14.	Subjective Testing of Tobaccos Treated with High-Flavored Maple	Robert J. Monroe, Professor of Experimental Statistics North Carolina State College Raleigh, North Carolina

Tuesday, October 30 (Continued)

2:30 p.m.

15.	The Color and Flavor of Maple Sirup	
	A. Chemical Factors	J. C. Underwood, Chemist Eastern Utilization Research Branch
	B. Microbiological Factors	L. L. Reed, Bacteriologist Eastern Utilization Research Branch

3:30 p.m.

16.	The Processing of Maple Sap to Sirup	C. O. Willits, In Charge, Maple Unit Eastern Utilization Research Branch

4:00 p.m. Laboratory Demonstrations on Maple Sap Processing

WELCOME AND OBJECTIVES OF THE CONFERENCE

by

P. A. Wells, Eastern Utilization Research Branch

Dr. Wells welcomed the conferees to the meeting. He pointed out that the sessions would be entirely informal, with time for discussion of each paper. Attention was called to the first and second maple conferences in November 1950 and November 1953, both of which were successful in bringing together those concerned with all phases of the industry for stimulating exchanges of views and ideas. The present conference is expected to achieve the same objectives.

Dr. Wells explained that he would be able to attend only the first day of the meeting, and that Dr. J. J. Willaman would serve as chairman in his absence. He reminded the conferees that cars would meet the early morning trains at Wyndmoor and Chestnut Hill, and that transportation back to the trains would be provided in the evening.

A report of the conference containing summaries of the papers will be prepared and a copy sent to each delegate to the meeting. Extra copies will be supplied on request.

THE OUTLOOK FOR VERMONT'S MAPLE INDUSTRY
and
THE EFFECTS OF VERMONT'S LAWS REGULATING RETAIL SALES OF MAPLE SIRUP

by

Fortis H. Abbott, Chairman, Vermont Maple Industry Council
Burlington, Vermont

The Outlook

We share with other maple producing states certain misgivings aroused by reports of a decline in the volume of production. For the figures, I refer you to the paper by Frank Rees of Vermont Maple Products Co. and to a recent bulletin of the University of Vermont and State Agricultural College, compiled by Geo. England and Enoch Thompkins, and from which I quote in presenting the statistical angle.

Mr. Rees has pointed out that the 1860 total U. S. production, expressed in sugar, was 64,723,000 lbs. and in 1952, 92 years later, it had dropped to 17,562,000 pounds, or 26%.

The University of Vermont bulletin (#593, June 1956) presents production for the years 1935 through 1954. Production of the five years ending in 1954, averaged, and applied against the 20 year average, shows a ratio of 78.8%, which might be compared in a general way with the 26% figure used by Mr. Rees.

At this point, I wish to throw a little wrench into the crop reporting system used for USDA reports for many years. I became a bit distrustful about the

reports while I was acting as a volunteer producer reporter; and when the opportunity presented itself in 1947 to assist in setting up a reporting system for maple in Vermont, which would cover production by grades and with prices, and to take part in the interpretation of the statistics, gathered and published weekly, I welcomed the chance to compare final volume calculations with those collected and published several months later by the official USDA crop reporting service. Without going into detail about the system involving up to 200 producer reporters, I can report that the final production figures for the years since 1947, by the Vermont method, show too much variation with the official USDA figures to be ignored. Figures for 1955 and 1956 are particularly out of line, showing a 22% and 31% discrepancy, the Vermont figures being lower. I hope that other maple states will look into this matter, so that further comparisons can be made. We need reliable figures for use as guides for the maple industry. A recent meeting of the Vermont Maple Industry Council endorsed continuance of the independent Vermont production survey.

It is not certain that this production shrinkage spells doom for the maple industry in Vermont, or in other States which have suffered a decline.

We have all discussed the commonly acknowledged and immediately visible factors that have discouraged production. I refer to:

1. Prices received by the producers
2. Demand for maple lumber
3. Lack of capital for purchase of equipment
4. Cost and availability of labor

I took part in a State-wide survey, in the late forties, one of the purposes of which was to establish the unfavorable factors affecting production. My recollection is that producers gave those four reasons in that order, to account for their decisions to cease or suspend production. More recent surveys have placed #4 at the top. It appears to me, however, that there may be certain underlying economic principles operating to bring about these unfavorable effects.

In the field of many agricultural and special products we observe the immense and direct effect of mass advertising upon sales and prices of the products involved. Citrus fruits, and more recently, milk, are illustrations. Maple has not yet devised a method of organizing for this benefit.

Unfortunately, in my opinion, such programs have involved legislation, and a consequential political flavor. We have failed to get legislative support for an industry tax and are now considering the possibility of a licensing tax to produce money for advertising as well as to strengthen the position of laws covering grades, labeling, adulteration, etc.

I am not competent to discuss the Canadian tariff on maple. Mr. Rees has presented this in a dramatic way by pointing out that, while maple production in the States has been falling, the production in the concentrated production area of Quebec has held its own and even increased. In 1930 the tariff operating

in favor of the States product was 45.8% of the average drum price. This was reduced to 33% in 1931; in 1942 to 19%; in 1948 to 6.2%; and in 1953 to 5.7%. There is no question in my mind about the handicap thus placed upon States producers, in view of the certain fact that production costs on this side of the line exceed Canadian costs by a percentage substantially above the 5.7% figure.

The demand for maple lumber needs no elaboration, except to note that the ratio of its stumpage value is presently about 8 to 1 when compared with the 1920-30 figures, while the producer's price for maple sirup shows a ratio of about 3 to 1 for the same period.

Local taxes, in my opinion, figure prominently in cutting maple lumber. Vermont, though still a long way from solving this angle of costs to the producer, has been exposed to efforts during the past three sessions of the legislature for passage of the so called "severance tax" on all forest production, in place of the "lump sum value" of property, which includes all land and buildings of the tax-payer. This idea has been rolling up support from lumber mill operators who own timber tracts, the Farm Bureau and many individual timber lot owners, as well as maple producers. I look forward to the time when Vermont will join 18 or more other States which already enjoy the benefits of this type of production encouragement.

The other two items, lack of capital for equipment and cost and availability of labor, appear to me to stem from obvious changes in economics which have affected farm operations in the areas of maple production in Vermont. These areas, back to 1890 and before, have been predominantly dairy farms, with maple as a side-line, or in many cases sharing as high as 50-50 on an income basis. Hundreds of Vermont communities were "maple minded" in those days. Schools were granted vacations so that the pupils might help in the sugar bush. The entire population looked forward with enthusiasm to the maple harvest season.

General thrift and savings, which were virtues in those days, have been replaced by a trend toward socialism and installment purchasing. Farm couples 30 to 35 years of age, in spite of generous government support in lending, are finding it harder to get together the down payment for the larger dairy farm unit which is necessary to operational success. Consequently sugar bush and timber reserves on many of these farms have been sacrificed for their immediate cash value to enable the purchaser to acquire an equity in a dairy farm that has lost its sugar bush.

The picture, however, is not entirely black. These same economic changes have provided some new machinery, particularly tractors, which are replacing horses in the sugar bush. Several lumber operators whom I know, who have heavy tractor equipment, have gone into the maple business. Their tractors make play of breaking the roads in the bush, and in gathering sap. These operators have the advantage of help which can be shifted from other operations when it is needed in a hurry in the bush. Once equipped with this machinery, the operator can use it more economically over a larger area. The number of operators of sugar bushes to the exclusion of other agriculture is on the increase. This is furnishing an impetus in the increase in the sizes of sugar bushes.

By combining bushes on adjacent farms, there have been several developments of 10,000 to 15,000-bucket size, and the number of those over 5000 has shown a substantial increase in the last five years.

While the price factor has lagged, in comparison with other products, over the long time spread of years, the shift in marketing practices in Vermont, from a wholesale tub sugar or drum basis to direct mail and retail packaging, has been of benefit to the producer by realizing a larger share of the consumer's dollar. It has been estimated from the survey of 265 Vermont producers that only 25% of the crop is sold on a drum basis to packers. Mail order sales account for 20% of the production.

Quality of product has played an important part in price adjustments and in marketing practices, which now aim at getting quart and pint containers as directly as possible into the consumer's refrigerator, where it is in a position and condition to compete with other table sirups.

Contrary to a popular assumption that packers and blenders are not interested in the fancy and grade A product, it is my observation that these grades are necessary to their business for the purpose of "toning up" lower grades and imports of block sugar, to cover the grade requirements imposed by the inclusion of flavor and color factors in the grade designations. Thus the effect upon wholesale or drum prices for Fancy and Grade A is at least favorable to the producer, though reluctantly acknowledged by packer-blenders.

The Effect of Vermont Laws Regulating Retail Sales of Maple Sirup

With respect to the second part of our topic, it appears to me that enough history of the Vermont laws concerning maple should be presented to establish a starting point. Consequently, I take you back to 1946 when the industry in Vermont was presented with price problems resulting from the war years' price of $3.39 per gallon.

The war years which had discouraged travel and large gatherings in general had affected the maple industry likewise. The Vermont Maple Sugar Makers Association, the only organized representation of the industry, had dwindled to a bare plus zero membership. Its revival at this time was a "natural." Packers as well as producers were extremely interested in prospective prices, and for the first time packers and retailers joined producers in consideration of this mutual problem. From meetings of individuals of these groups the basic ideas about more orderly merchandising were developed. Meetings of the reorganized Sugar Makers Association were held in all counties of the State. These meetings developed enough uniformity of thinking so that by 1949 the industry was ready to present a bill to the legislature.

This is embraced in Chapter 226 of the 1947 revision of the Vermont Statutes. Without quoting verbatim from the law, I express it in the following terms: It calls for something new in the trade--a system of marketing definitely under grade regulations with the use of a seal on each retail container; marking includes name and address of producer and packer; true name of product and year of manufacture; grade and contents of the container; seal must be so affixed that container cannot be opened without breaking the seal. This became effective on March 1, 1950.

After one year's experience with this basic law, 5 changes were made by the legislature in 1951 at the request of the industry, as follows:

1. Year of manufacture was written out.

2. Permitted the contents to be stated in fluid ounces.

3. Roadside signs showing prices must also show grades.

4. Penalty for violation changed from $5.00 per gallon to $5.00 per violation.

5. Bleached sirup may not be marked or marketed as pure maple.

In 1953 additional legislation was enacted in an effort to strengthen the authority of enforcement agents. This took two branches:

1. Power of embargo. This enabled inspectors to seal unqualified products on the spot.

2. It covered the authority of enforcement agents to inspect and embargo within the state products intended for out-of-state shipment.

In 1955 additional legislation covered hotel, restaurant, and eating places by controlling labels and advertising designed to inform the public if the product offered is a blend, imitation, or pure maple. One other important act in 1955 authorized concurrent jurisdiction with the State Board of Health for enforcement of regulations on maple.

The enforcement of these laws is the responsibility of the Vermont Department of Agriculture. Under the Commissioner of Agriculture it has four departments. The first three, dairy, weights and measures, animal or veterinarian, are organized each with their specialized employees. The fourth department embraces maple and apples, potatoes, poultry and poultry disease, and eggs. This department employs six field men, four of whom are assigned to the poultry and egg division. The other two, while primarily assigned to maple specifications, are also involved with enforcement problems concerning apples and potatoes.

The fields of inspection covered by these men involve a rough classification as follows:

16 to 20 packers of maple products (roughly these would be businesses of a size involving a thousand gallons or more)

About 1000 retailers (this would include largely stores and retail outlets, hotels and restaurants)

2200 or more producers

I am informed that in 12 months the two men made 3516 field calls.

Other activities of the office included sale of 846 grading sets and 40 hydrometers in 1954; 1009 grading sets and 17 hydrometers in 1955; during last year they report 365 hydrometers tested, and returned or exchanged for new ones.

Laboratory equipment available in the Department of Agriculture for handling maple samples is extremely limited. It includes equipment for conductivity tests, density, and color. For finer points of adulteration, ash tests, etc., it has been necessary to turn samples over to the State Health Laboratory. Research and biological work is carried on by the State University and Experiment Station and has no direct relation to the State Department of Agriculture.

In the first place we must admit that in spite of the comparatively easily secured legislation, it could not be claimed that it was popular with either producers, packers or retailers. The sealing of the individual packages, which had to be rushed into effect, turned out to present a ragged variety of seals. The screw cover type of can was being replaced by the "Upressit" type, which has since simplified the application of numbers assigned to the individual packer which are required on the can as a means of identification.

Introduction of the sealed can with the grade designations and contents stated thereon immediately made it necessary for hundreds of individual producer-packers to pay more attention to density, flavor and color. It is possible some producers gave up sugaring on account of what they classed as "red tape." There is also likelihood that some producers who had been packaging for retail trade turned their product into central packing houses, rather than bother with the detail of following the law. It is also certain that a few producers and packers resented this interference and disregarded the law openly or "under the counter."

For many years producers and packers had been exposed to a variety of makes of cans for use in packing sirup. To my knowledge no one manufacturer provided a full set from half-pint to the gallon size which would calibrate to the correct size to contain a hot-pack maple sirup. This has since been partially remedied by certain manufacturers; however, total contents of the package still present one of the problems of inspection and enforcement.

The system of keeping records of all calls, inspections and violations has necessarily been changed in several respects since the inauguration of the law. Consequently we are unable to present comparisons from year to year with respect to the character of the violation. Inspectors are looking for violations of five general types: appearance and sealing of container, color, density, flavor and adulteration.

In the administration of this law in the early years the violations most commonly observed were those of density and flavor, and many of these were real bad. I am informed that while these violations still appear, the degree of violation is much less. Improvement in the hydrometer, whereby closer readings can be made by the packer, have helped to cure the difficulties with density. Early tendencies to up-grade A colors into the Fancy column and high B colors into the A column have become less troublesome.

Adulteration can be definitely stated as the most difficult of the regulations from an enforcement standpoint. Lack of fully reliable physical tests of the product is the most severe handicap which faces the enforcement officer. The policy of the department is to approach enforcement from the educational and information angle rather than looking for opportunities to prosecute minor violations. The system of inspections includes a report on each violation but warnings have cured many of the original and perhaps unintentional violations;

however, the report system develops a file for the individual packer and producer and repeated violations become the cause of a more severe crack-down.

Actually, the five years of experience with the adulteration part of the law has produced three completed prosecutions. One was carried through to a $2000 fine and costs in court. Two others of a minor nature have been completed with a $100 fine and costs. In the latter case the conviction came about through tracing the purchase and use of the adulterant rather than from any test on the resulting blend. Large scale cases of adulteration would not be approachable by this method. The industry badly needs a method which will reveal the nature and amount of adulterant.

The program of education and information as carried out by the enforcement officer, and influenced by a genial but firm attitude, has paid off in the administration of the law.

Grading has proved its value not only to producers and retailers but has been well accepted by the consumer. All concerned have learned that this method of merchandising is of advantage to every segment of the industry. Consequently packing plants and producers as well as retailers are always glad to have inspectors drop in. It is not to be inferred that the inspectors are making social calls. Violators, intentional or otherwise, do constantly appear. This is only normal since the personnel of the industry is constantly changing and increasing by leaps and bounds in the category of retail outlets throughout the State.

From personal experience I can state that packers have been genuinely cordial and thankful when presented with an off-grade sample of their own product. I am convinced that they believe that the law should be enforced for the good of the industry.

While the establishment of the grades for the maple product is the basic tool of the law, experience has indicated that the embargo feature, added in 1953, provides the necessary wrench with which to tighten down the cover.

To my knowledge, much of the success of administration of the law has been due to the interest in the industry, and the consideration of the people involved in production and packing that has been exhibited by the field men, as they prefer to be called, instead of enforcement officers.

In Conclusion

The outlook for Vermont's Maple Industry is not bright from the standpoint of volume; however, the last 5 years' records indicate that the rate of loss has slowed, and the volume may soon reach a more stable point, probably at the gallonage of around 500,000. Quality and marketing factors have been steadily improving with a larger share of the consumer's dollar going to the producer. Cost and availability of labor, together with Canadian tariff adjustments, present immediate problems. Operations will involve larger units with higher efficiency.

The effect of Vermont's laws has proved favorable to the industry, and they have been so administered that there is a minimum of friction among the

segments of the industry and the enforcement officers. The detection of adulterants and their identification is now the number one problem.

THE CANADIAN MAPLE SIRUP SITUATION

by
George Vallières, Department of Agriculture
Province of Quebec, Canada

Let my first words be an expression of thanks to the Organization Committee which made this get-together possible and thus further the interest scientific personnel is giving the Maple Industry. I consider it a great opportunity to be here today for three reasons: first, the pleasure of making known, perhaps a little better, the Maple Industry of "La Province de Quebec"; secondly, to learn a lot from whom we generally say is our great neighbor; and, in the third place but not the least, to meet old friends and make new acquaintances.

During the past 300 years, many changes have marked the evolution of maple sugar and maple sirup making. Maple products in those early days were made only for the use of the family. It has been only during the last 100 years that better methods of production have been gradually adopted by sugar makers. The ease of sale, constant and increasing demand for maple products, and a desire to make their work easier, have encouraged sugar makers to improve their methods. Nowadays, sugar bush equipment is either of plastic, aluminum, tin plate or stainless steel. These accessories make cleanliness easier, last longer, and assure a maximum of quality and income.

By answering the following questions, I hope to give you an idea of the maple industry in Canada.

What is the size of the Canadian production? What is its variation from year to year? What percentage is exported out of Canada? How is the sirup inspected and graded? And finally I shall report the result of an experiment underway at the Experimental Sugar Bush in Plessisville that may interest you.

Canadian Production

There are approximately 70,000,000 maple trees in eastern Canada. Over 20,000,000 of these are tapped yearly in the Province of Quebec. This shows that the possibilities of the industry are very promising and make it one of the most important in agricultural Quebec.

In Canada, the Province of Quebec is by far the leader in this field. In fact, it supplies 85% to 90% of the Canadian production. Out of the 155,000 agricultural farms in the Province, more than 25,000 have sugar bushes.

Statistics for the years extending from 1942 to 1955 show that the highest production year was 1947, with 3,928,000 gallons of maple sirup, and the lowest year, 1945, with 1,530,000 gallons, the average being 2,600,000 gallons.

For the period covered by statistics, approximately the same number of trees are tapped annually, but there is a wide variation in the crop, principally due, as you are aware, to weather conditions during the sugar season. Even throughout the Province, certain years are favorable for the eastern townships in the southern tip of the Province, and other years for the more northern regions of Quebec and in the lower St. Lawrence Valley.

Dr. Frank Rees, in a wonderful talk three years ago, discussing a balance sheet of the United States maple industry, pointed out a tremendous decline in the number of trees tapped in your country, the decrease being from 12,341,000 to 6,950,000, or a reduction of 43%. Dr. Rees said that Canada had not experienced a similar decrease in production. Farm economy in the Province of Quebec is greatly different from that in the producing areas of the United States. But the industrialization of the Province is going on at a tremendous pace. All the farm problems that accompany such an evolution are present. As a consequence, it is becoming more and more difficult to get labor for the sugar season. Even domestic labor, which was the basis of farming, is being attracted and taken up little by little by industry which can offer better salaries and better working conditions. These causes hamper the growth of the maple industry and the tapping of more maple trees in the Province.

Exportation

The keeping of all this flavor and sweetness for ourselves would certainly be unjust and deprive thousands of consumers of such a delicacy, and would also be unsound economy. So a certain proportion is exported to your country.

The exports of maple products vary from year to year. As a general rule, if production is high, exports increase and diminish with lower production. Up to 1930 approximately 20% of the crop was going across the border. From 1930 to 1940, 25%. From 1940 to 1948, 30% and since 1948 it has reached to 43% of the Canadian maple sirup production.

Inspection and Grading

How is the sirup bought by American companies inspected and graded? An example will clearly illustrate the procedure. The farmer who produces the sirup will go, on a previously determined day, and offer his products for sale. The drum will be placed on the scale and a sample taken by the grader, who will grade the sirup according to the Quebec color standards. A total solids reading in °Brix will also be taken by the grader. The sample will afterwards be passed on to a technician who will apply the conductivity test. If the conductivity value is that of pure maple products all will continue on normally. If this value is too low or too high, procedures will be immediately taken by an inspector to seize the maple sirup, and two new samples will be prepared in special sealed containers, one of which is sent to the central laboratory in Quebec and the other given the farmer as check sample. Everything is very easy as the three government officers needed to apply the law are all at the same spot and travel together in the same car. At the laboratory, the sample will be thoroughly analyzed and, depending on the results, the sample found pure or adulterated. If pure, the seizure will be lifted and, if adulterated, the product will be confiscated and, if edible, given away to charitable institutions.

From nine to twelve of these conductivity teams can be on the road and during the sugar season, which occurs before the commercial trade begins, these men visit all the domestic markets in the Province to protect the consumer. Then, when wholesale buying begins at all the centers a conductivity team is put at the disposal of the wholesale buyers.

Statistics on Grading of Commercial Maple Sirup from 1949 to 1955

It is very difficult to produce choice maple sirup. This quality is certainly the very pick of the crop, as the average for seven years is not quite 1% of the production. Even A grade, which is not much darker than American Choice Sirup, reaches an average of 20%. Here a remark is necessary. We know by inspection that a good part of the sirup sold on the domestic markets of the Province is of A or AA grade. This lowers considerably the amount of high-grade sirup available for wholesale purposes.

Color is the basis of grading Canadian sirup, but the law states very clearly that concentration, maple flavor, off-taste, inadequate filtration are all factors that influence grading.

The authorities who desire a constant increase in quality have applied certain measures accordingly. Every sugar season instructors from the Provincial Department visit hundreds of sugar camps to give invaluable information to the sugar makers. In an effort to eliminate lead the Government of the Province of Quebec and the Federal Government of Canada have helped the sugar makers in changing, at fractional cost, the old buckets for new aluminum ones. As a result, of the 22,000,000 buckets utilized last year over 15,000,000 were of aluminum. The Quebec Department of Agriculture will continue its contribution to this exchange.

Experimental Work

Finally, I would like to pass on the results of an experiment made at the Experimental Sugar Bush during three years--1954-55-56--to determine the efficiency of the molded aluminum improved spout.

The tappings were distributed as uniformly as possible on sound maple trees, on soils offering similar conditions, elevation and drainage. The chosen trees had similar crowns per pair of spouts and the diameter of the bore was that recommended by the manufacturer. An old experienced instructor of the maple industry was at hand for the tapping. Fifty trees were tapped with the new molded aluminum spout and fifty with different old type spouts. The fact that during our three years of experimentation the quantity of sap recorded for the new spouts was never surpassed can be brought as evidence of its superiority.

The percentage of increased production with the new spouts was as follows: 1954, 25% more sugar; 1955, 23% more sugar by sap flow and 6% more if the percentage of solids is taken into consideration; 1956, 17.7% more sugar. This means an average of 21% more sugar than with old type spouts.

With these few landmarks I hope I have given you a general idea of the maple industry in Canada, and especially in the Province of Quebec. If anyone would like more data on certain topics, I will try to answer within the field of my knowledge.

OHIO'S MAPLE FESTIVAL AND ITS EFFECT ON OHIO'S MAPLE INDUSTRY

by
Ture L. Johnson, State Forester
Burton, Ohio

Greetings are extended to you all from the Geauga County Maple Festival Board members. The board is represented here today by the originator and former chairman, and his wife, Mr. and Mrs. A. B. Carlson, plus the county agent, Mr. Leland Schuler, Mr. Paul Richards, and myself. The job of chairman has been assumed by myself again for this coming spring, and we extend an invitation to all of you to come.

The topic, "Ohio's Maple Festival and Its Effect on Ohio's Maple Industry," has been assigned to me. Back some 50 years ago, the maple industry in Ohio was booming, with the result that large quantities became available for a limited market and maple became a surplus commodity.

Sirup in those days sold for 75 cents a gallon, and every producer was pleased to dispose of his product for this price. However, many producers retained their supply because they lived on roads impassable for an automobile, and in some instances nonnavigable for horse-drawn vehicles.

We want to remember that this 75 cents was a wholesale price, while today nearly all of our sirup is sold at retail as a direct result of the publicity and advertising given the industry by the Festival.

Some of our farmers that produce sirup are not in the best financial condition, and depend to a great degree on the sale of sirup to carry the load for the purchase of fertilizer, seed and equipment to round out the general farm program for the year. With this problem of surplus late in the season many producers became desperate and sold for whatever they could get. This resulted in much sirup selling for less than 75 cents per gallon.

Thirty years ago a few merchants of Geauga County interested in improving the purchasing power of the farmer held a meeting about the problem, and from this meeting was born the Geauga County Maple Festival. Five years later (1931) the Burton Chamber of Commerce decided to do something about the promotion of sirup sales for their membership, and from their meeting was started the construction of the log cabin on the Village Commons, which is used each spring as the clearing house for sales of sirup, cream, and sugar cakes. The log cabin deal in Burton is more educational than our Maple Festival as it is operating during the sap runs, and people can actually watch the sirup being produced, plus the cream, and sugar cakes being made. There have been Sunday sales of over $5000, which represents many pounds of cream, sugar cakes and packaged maple sirup.

Many different groups and organizations are now capitalizing on the maple industry, by serving pancake, sausage and sirup dinners on Sundays. We have groups such as Rotary clubs, fire departments, scouts, and fraternal lodges serving these dinners during the sirup season and really making money for their efforts. One organization has served over 2400 people in one day of operation, and for the season has averaged 12,000 people. Last year they were putting through an average of 135 people every 25 minutes. That's a lot of sausage and pancakes.

We must remember that we have a drawing card practically in the center of 2-1/2 to 3 million people. Our own county population has more than doubled in the past 15 years.

We of the Festival board, with television appearances, radio broadcasts, and other advertising are the promoters of all this sirup business in the area. Very little money is spent by the Festival board in live broadcasts previous to the Festival. During the Festival we have an outlay of money for telephone line rental in order to have live broadcasts on the grounds. This year we hope to be better covered than last year.

It might be well to say here that we are getting excellent cooperation from the large metropolitan newspapers in free publicity and awards. The Cleveland Plain Dealer, for instance, has given the producer of the sirup judged to be best an immense attractive trophy. The Cleveland Press has supplied 25,000 programs and recipes free. Practically all the other newspapers have some part in the program, such as the Geauga Record putting on, at their expense, the Old Timers' party, and the Painesville Telegraph and Geauga Times Leader putting on the Golden Wedding dinner.

We have the cooperation of a majority of our full time producers, who donate 1 gallon of their best sirup to help us defray the Festival expenses. From this donation are taken samples of sirup to be judged for the Plain Dealer Cup, as well as samples for the display booth; all sirup left over is put into our hot sirup stir booth.

A tip to anyone interested in starting a Festival would be to make sure of the quality of your sirup. For two years now we have had one concern, Will Richard Co. to buy and package all of the sirup sold at the Festival. They also have furnished the maple products such as cream (fondant) and sugar cakes. For several years we have had one organization to head up our sales at the Festival, and mail orders.

One of the big sales media which up to now we have neglected to mention is our roadside stand operators. There have been seasons when these people gave us a hard time by cutting prices, but the problem has been more or less overcome through education, and I do not believe we have many operators that have to cut their price below ours to sell the product if it is a well-manufactured commodity. The sirup sold at the Festival is guaranteed in that if it should be dirty, off taste or off color the purchaser can return what he bought and get a similar quantity at no cost.

In discussing roadside stand sales, I forgot to mention that Chardon is located on two busy state highways, and when you can get cars bumper to bumper and no place to go but sit in the car it makes for good business along the highways. This year I was able to get the State Highway Department to set up five automobile counters for us, and we got an estimate of the traffic. The high over one meter was 552 cars per hour, with others registering over 400, 300, etc., cars per hour. Our greatest bottleneck has been parking, but it is becoming better with new shopping centers nearby with vast parking areas. People shuttle from here to the Festival grounds in busses. Also, many of our visitors are coming by special trains. This year we had some 1200 people come in two trains from points 80 miles south of Chardon. We had members of our board, plus the Maple Queen and her court, meet the trains in advantageous

spots and accompany the folks to Chardon. This gets the people in the spirit of the spring season and they are ready to burst at the seams when they arrive at the Festival. This year we rigged up a maple products stand on a truck and took it to the depot so the train commuters could make their purchase before departure, thus eliminating the bother of carrying maple products around the grounds of the Festival.

The Festival Board realizes the monotony of having nothing to do upon arrival at the Festival, so we have activities scheduled for all hours of the day, which are announced over our P.A. system covering the area. The local Boy Scout troops are the sole engineers for the entire nerve system, and believe me this is a busy spot.

Some of the activities going on:

1. Logging, sawing and chopping contest.
2. Boy Scout contest--building camp fires and frying pancakes.
3. A Grand Parade, with 10 high school bands participating.
4. Horse pulling contest.
5. Explanation in evaporator house on how sirup is made.
6. Plays put on by theatrical groups.
7. Sheriff posse parade.
8. Exhibits of maple products and sirup.
9. Exhibits of antiques.
10. Presentation of the Governor, who awards the Plain Dealer Cup.
11. Presentation of the U. S. Senator who gives a short nonpolitical address.
12. Plus all the concessions on the grounds.

This Festival is held out in the open, so we have to rent a tent for many concessions and for the sale of Festival sirup. We charge $10 per foot frontage for space in the tent and $6 per foot outside on the grounds. There has been an ever constant vigil on these concessionaires and each year they are reviewed to see if they are desirable or undesirable.

So you can see that we have things going on to entertain most of the people.

A month after the Festival was over, I sent a questionnaire to the producers to find out how much good maple sirup was left, and got 6 replies for a total of 495 gallons, 315 half gallons, 50 quarts, and 40 pints. This undoubtedly will be channeled into some companies that will want it for Christmas gifts.

In closing, it can be safely said that the Festival has been the answer to the promotion of sirup sales in northeastern Ohio.

REPORT OF PROCEEDINGS OF THE FOREST RESEARCH ADVISORY COMMITTEE

by
P. Dewey Lyman
White River Junction, Vermont

Before making remarks relative to the proceedings of the Forest Research Advisory Committee meetings it seems fitting that something be said with regard to the history of the Research Advisory Committees, who they are, how appointed and their functions.

There are about 25 of these committees. All are appointed by the Secretary of Agriculture under the provision of the Research and Marketing Act of 1946.

Some are concerned with particular farm commodities, while others advise on research in specific functional areas. In addition to these there is also a National Advisory group, the Agricultural Research Policy Committee, which is concerned with the broader aspects of the U.S.D.A. research program. This committee I believe holds meetings quarterly. All of the others meet once annually.

The membership of the research advisory committees, usually of eleven members, consists of five or six producers, geographically distributed to provide representation of major producing areas, four or five processors or distributors or persons engaged in these activities, and one member engaged in or responsible for research. Also on each committee is one representative of a State Experiment Station or State Extension Service.

Within their respective fields advisory committee members endeavor to acquaint themselves with the problems of producers, as well as of all other segments of the industry and present them for consideration.

The committees are expected to review and evaluate the current research and marketing service of the Department, including work under way by Federal Agencies and field stations. Sometimes recommendations for adjustments in the Department program, including priorities for new work or possibly adjustments in work under way, are made.

According to their ability members endeavor to assist in developing a better understanding of the nature and value of an agricultural research program, explain it to interested persons, groups or organizations and encourage wider and more rapid applications of research findings.

They are also urged to be active in assisting those responsible for the conduct of research work to obtain the cooperation of producers, processors, distributors and consumers.

This briefly brings my remarks up to the Report of the Forest Research Advisory Committee meeting held in Washington, February 1-3, 1956, which was the first such meeting I had attended since my appointment in September, 1954. Because of illness, I did not attend the meeting held that year in November.

May I, at this time, take the personal privilege to say that nothing pretentious is intended for my part, but rather I feel very humble indeed to have

been chosen to serve on this committee, fortunate to have had an opportunity to join the other members of the committee in their deliberations with the staff members and personnel of the Forest Research Service. The cordial reception extended to me by everyone was significant of their high character and caliber. Their manner of deliberations was very impressive.

I like to interpret the word advisory to mean to be advised as well as to give advice, and that just about describes how these advisory committees function.

The Committee considered 37 research proposals. Among these were proposals for "Forest Products Utilization: study utilization of mill residues, with effort directed toward (a) use of whole wood fiber to produce high-yield pulps and (b) production of chemicals especially from sawdust and shavings. Expand research on naval stores and for maple products." The expanded work on maple included (1) improved filtering techniques for sirup, (2) development of improved packaging techniques, (3) investigate the use of idle milk plants as central sirup processing plants. (The above are in addition to the research investigations now being conducted at the EURB or under contract with State Experiment Stations marketing research.) The committee also recommended expanded research to improve the existing procedures for marketing forest products. Maple sirup was specifically cited as one of those forest products that should receive attention.

I hope in the future to stress the need for research on preservation and replacement of our maple trees. These are one North American heritage and we must do something to off-set the ravages of the lumber mill and from forest insects and damage sustained from tapping.

ECONOMIC TRENDS IN MAPLE SIRUP - PRODUCTION AND SALES

by
Edward R. Boylan, Cary Maple Sugar Company, Inc.
St. Johnsbury, Vermont

In the years of 1930, there were four major classifications of trade which formed markets for products of the maple industry. These markets may be liste as follows: (1) the tobacco industry, (2) the blending industry, (3) the flavoring industries, which include ice cream manufacturers, bakeries, candy-makers, etc., and (4) the direct consumption or the retail market.

Tobacco industry. In the 1930's and the early part of the 1940's the tobacco industry was a very large user of maple sirup and sugar. One tobacco manufacturer used a million pounds of maple sugar a year, another used as much as two million pounds, and still another used between three and four million pounds a year. Other manufacturers in this industry probably used an average of 400,000 pounds a year. This market represented a very large portion of the total maple crop each year. Today this market has virtually been lost and there is approximately only 200,000 pounds used in the tobacco industry today. There is doubt that this market can be recovered.

Blending industry. The maple and cane blender is a great friend of the pure maple industry. The blenders create a market for the dark sirups that are

made by the maple producer. At one time there were a large number of blenders and several were 10 carload buyers. Today, however, the number of blenders is small and there are only 3 or 4 large blenders.

Flavoring industry. At one time the use of maple for flavoring represented a substantial market. Ice cream manufacturers used 100% pure maple for flavoring as did the baking and candy industries. Today, these manufacturers have abandoned the use of pure maple and are using imitation maple for flavoring.

Direct consumption. During the 1930's a fair retail trade for maple sirup had been built up but during the years of World War II pure maple did not reach the store shelves. Since that time there has been a drive to put pure maple back on the shelves of the stores. Today it is available in stores in every part of the country. This source of outlet is as important as the roadside stand.

How are we to educate the people that pure maple sirup is available? At the Cary plant in St. Johnsbury, Vermont, conducted tours are arranged for the visitors and they are shown movies of the various aspects in the maple industry. This plant has had as many as 400 visitors a day and a comment generally made is, "It is too bad we can't buy pure maple in our home town." Since pure maple is available throughout the country, there must be a lack of publicity.

An institute for publicity was formed and since then Mr. Boylan has had the opportunity to make several radio and television appearances attempting to get the message to the people that 100% pure maple sirup is available at the store level. At the present time there is great competition between pure maple sirup and imitation maple sirup. The sales of imitation are increasing and present a very serious problem. The maple industry has lost markets to the tobacco and flavoring industries and now it is feared that there may be a loss to the blenders because of imitation maple. Some of the largest grocery chains in the country have their own brands of imitation maple on the shelves and undoubtedly other chains will follow this course. The maple industry must use whatever means available--newspapers, radio, television--to promote pure maple sirup.

Discussion

Question: What is the outlook for maple as a surplus crop?

Answer: In most years there may be a small carry-over but it appears that there may be a large carry-over this year.

Question: What was the cause of the lost market in the tobacco industry?

Answer: There are two causes for the loss--price and availability. At the time the tobacco industry was using 7 to 8 million pounds of maple a year the price was low but the maple industry was unable to supply the required quantity of maple. This resulted in a cutback of the amount of maple used in tobacco. Later on when the price of maple was increased the tobacco industry cut out maple entirely.

AGRICULTURAL EXTENSION ASSISTANCE IN MAPLE SIRUP PRODUCTION

by
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Madison, Wisconsin

All maple sirup producing states appear to share a kindred history in a transition period from crude production methods used by Indians to only moderately improved procedures developed by white settlers. In Wisconsin, for instance, we have the records of one family in Waukesha County, in the southeastern part of the state, showing 100 years of continuous sirup and sugar making in the same woods. These records further show that Indians had been using the woods for the same purpose immediately preceeding, and long before the ancestors of the present Martin family obtained title to the land. Cedar-stave gathering pails, an iron kettle, and the brace and bit constituted the principal items of advance over indian methods of a century ago.

If early agricultural census records are reliable, Wisconsin can claim one transitory "first" in the long history of maple sugar manufacturing in the nation. In 1864 Dodge County, in the southeastern part of the state, was credited with the largest volume of maple sugar produced in any County in the nation that year. Obviously, the Civil War had something to do with incentive to produce maple sugar.

In the early 1930's county agricultural agents in three distinct sirup producing areas of the state, with the assistance of the Marketing Bureau of the State Department of Agriculture, promoted the formation of local producer-cooperatives, one of which achieved some degree of distinction by contracting with a recently formed dairy cooperative to finish partly evaporated sap in the vacuum unit installed by the dairy group to evaporate milk. The process yielded a high quality sirup, but the inconveniences of shifting nightly during the sap season, to maple sap from milk, plus the prompt growth in volume of the dairy products handled by the plant forced abandonment of the maple sideline.

The first national conference on maple sirup and sugar production, held here in late 1950, may be quite correctly recorded as sparking the first statewide maple project in Wisconsin as an integrated project in the agricultural extension program of the state. Its implementation and direction centered in the Extension Forestry Office of the College of Agriculture. It received the active cooperation of the agricultural agents in twenty counties. Its purpose has been to increase net income to the producer through more efficient operations, higher quality of product, wider markets for the finished product, and expansion of operations wherever possible to reduce unit costs in production.

Agricultural extension workers recognize the effectiveness of subject-matter meetings in focusing attention on objectives and promoting wider acceptance of recommended practices. The one day maple sirup producers' institute was chosen as the type of meeting with greatest potential for reaching large and small producers throughout the state. Eleven major producing areas were charted, and for the past six years annual one-day institutes have been held in each of these areas.

We have always considered the timing of these institutes of major importance. It's often uncomfortable to hold these meetings in January, as anyone familiar

with the vagaries of a Wisconsin winter can testify. But institutes have provided more than a series of talks. Beginning with the initial series of annual meetings of producers we have invited equipment distributors to display their wares. We have never had fewer than two distributors in attendance; currently we have three. We believe it is not enough to report to our producers the latest findings of research here in Philadelphia, and of the several state stations. We want them to see what the manufacturers of equipment have to offer, which is one of the best means of applying the results of new findings. We want them to compare designs in equipment, to compare prices, and to get the benefit of suggestions from the equipment distributors who, fortunately in our state, are highly skilled sirup makers. Most important of all, if at the meeting they become convinced it is to their interest to purchase new equipment, an order placed in January is reasonable assurance they can get delivery on their purchases before the sirup making season begins.

Emphasis may change from year to year on subject matter useful to the producer. One year, for example, variations in unit costs of production, based on cost analysis records, were highlighted. Steps toward effective bacterial control, types of evaporators offered, firing the evaporator, marketing opportunities, and application of grade labeling, are some of the more important topics which have been presented through lectures, motion pictures, working models and panel discussions.

The Agricultural Census of 1955 reported approximately 2300 sirup producers in the state. We know that nearly half of this number make sirup exclusively for home consumption. Attendance at our institutes totals about 500 for the whole series each year. Through a register of attendance taken at every meeting we have the names of over 1200 active producers who have attended one or more institutes in the past six years. These names constitute our mailing list for a maple producers newsletter, sent at infrequent intervals, prepared in the Extension Forestry Office.

A project that is worth the effort expended in field meetings in January is certain to be more fruitful if contacts are maintained throughout the year. In the absence of a statewide organization, for which there seems to be very little interest in the state, the sirup producers' newsletter appears to be an effective medium between Agricultural Extension and the producers. Preparing it is not a chore, but often the editor wishes he had more comments and suggestions from which to draw. Producers like to know of activities in other states, as well as of what their neighbors are doing. An exchange of newsletters with other states, if such letters exist, or can be established in the several states, could be most helpful to the industry.

To get some measure of the extent to which the letter is read by producers we ran a short note about the forthcoming sirup producers handbook which Dr. Willits, through this Laboratory, has submitted to the Government Printing Office. Even though it was explained that we could not expect the Handbook before 1957, the number of requests received for copies left no doubt that producers took note of this fine work, and that it will be widely distributed to producers in the state.

As an extension project, maple sirup promotion is proving to be a timely one, the massive inroads of bowling pin and yo-yo manufacturers notwithstanding. Ever since World War I there has been unceasing pressure on the dairy cow in

Wisconsin to provide a larger share of the total farm income. The geographical distribution of the marginal dairy producer, fortunately or unfortunately, in Wisconsin largely overlaps the distribution of maple woods, the quality of which offers the greatest possibilities for expansion. Many dairy producers recognize that the answer to their economic problems does not lie in still more pressure on the dairy cow. The market for maple products is by no means saturated in the Middle West. Agricultural extension is now turning the spotlight on opportunities in making and marketing maple sweets. The experience of the past six years in bringing to the owners of maple woods the opportunities for profitable sirup production, and the technical information developed by this Laboratory, promise to be put to more effective ends in the next decade.

MAPLE SIRUP EVAPORATORS - OLD AND NEW

by
Alton E. Lynde, Manager, Leader Evaporator Company
Burlington, Vermont

No one really knows when maple sirup and sugar were first made. There can be little question but what the American Indian was the first sugar maker. There are many legends regarding the actual discovery of maple sirup. One can find several of them in the "Maple Sugar Book" written by Helen and Scott Nearing.

Whether it was a wooden bowl or a hollowed out stone that was the first evaporator is a question hard to answer but it is almost certain that the heat was supplied by dropping heated stones into the sap until it was boiled or evaporated down to a sticky substance that might come close to some of the very dark and dirty sirup that sometimes faces our dealers today which comes from the cleaning up of the evaporator--sometimes a week or two after sugaring is over.

From this crude beginning, we are told that the Indians advanced a little but it wasn't until the advent of the white settlers that metal containers were used. At first it was the iron kettle, which was used for so many purposes, hanging over the fire by an iron chain suspended to a tripod of three wooden poles. This was the only method used for years. I can remember seeing them used quite frequently back in my boyhood days and know of two or three instances where they are in use today. The product made from the kettles was usually very dark in color but strong in maple flavor. Sap was dumped into the kettles regularly during the day and sirup was usually taken off at the end of the day in one big batch.

From the iron kettle, the next step was the flat bottom black iron pans. This iron was sometimes called Russian Iron and was so pure that it seldom rusted. There were many different types of pans made. Every local tinsmith had his own ideas. Some were large and had partitions; others did not. There were pans consisting of a series of small pans in a row from which sap was dipped from one to another as it got sweeter. When galvanized iron and the English tinned sheets became available, this material was used instead of the black iron.

Around the latter part of the 19th century, short heating pans began to appear in an effort to conserve heat and enable faster evaporation. These were usually about two feet long and were tubular or flue type design. Some were deep round cups which were staggered for more efficient use of the blaze.

It was many years before evaporators were made by any company making it a major part of their business. I do not know, but believe that the Vermont Farm Machine Company of Bellows Falls, Vt., was one of the earliest to make maple sirup evaporators. I have no information on what their first evaporator was like but it became widely known as the Improved Williams. Everyone in that locality called it the Bellows Falls from the town in which it was made.

The Williams, as far as I know, was one of the first evaporators in which any attempt was made to increase the heating surface over a flat bottom pan. It was one of the first to have circulating partitions. These partitions were approximately two inches high and were folded in out of the metal and the bottom spread so the sides had the appearance of an inverted V. The fire and heat could hit the sides so that some extra heating surface was obtained. The sap was fed in at the front and traveled to the back end, passing around and between the partitions, which were about twelve inches apart. Because of shallow boiling and continuous circulation and the fact that considerable time was taken for the sap to reach the sirup stage, the caramelization process, which we now know to be responsible for the maple flavor, was carried out to such an extent that undoubtedly our old time sugar makers were very right in contending that this evaporator and other flat bottom pans made a better flavored sirup than some of our faster boiling evaporators which followed them. The Williams evaporator was very popular up until World War I when the company went out of business.

Another of the earliest companies to start making evaporators was the G. H. Grimm Company of Rutland, Vt. I do not know just when this company actually started, but probably around 1880. One of its first evaporators was known as the Grimm Champion. This pan consisted of a corrugated flue pan over the fire and two or more flat sirup pans at the back end near the stack or chimney. I might add that up until this time most of the arches had been made of stone or brick with brick chimneys. The corrugations in this pan were about 1-1/2 inches deep and about the same distance apart. They were raised up into the pan rather than dropping below the arch level. This just about doubled the heating surface of a flat bottom pan the same size. I believe that more sugarmakers have used this Champion evaporator than any other make, as they were well distributed, the company having a branch factory in Hudson, Ohio, and another in Montreal. The corrugated pan and the sirup pans are still used by the Grimm Company today but mostly in connection with a deep flue pan in back.

Thus up until 1888, only the Williams and Grimm Champion pans and other flat bottom types were used in this country along with the kettles. While on the subject of flat bottom pans, I will mention a few of the others that were made during this period and a little later:

Granite State--similar to the Williams and made in Marlow, N. H.

Keystone, which consisted of a series of flat pans--J. H. Sproul Hdw., Delevan, N. Y.

Parks & Barker, also a series of pans made in Ohio around 1890-1940.

Warren, with a series of pans, Warren, Ohio, from 1890-1925.

In 1888, a deep flue type evaporator was invented by Clark Hall and William Henry Wright of East Farnham, Quebec, and patented in both Canada and the United States. The patent rights were obtained by William E. Burt of Enosburg Falls, Vt., who made the first drop flue evaporator in this country. His company was called the Leader Evaporator Company, and the evaporator, the Leader. You might be interested in knowing that Mr. Burt continued in the business up until a little over a year ago when he passed away after serving the industry sixty-seven years.

At first the flues were 9 inches deep and somewhat wider than at present. They are now 7-1/2 inches deep and 5/8 inch wide. The front half of the pan was flat with circulating partitions and the back half contained the flues in the middle of the pan with a flat sirup compartment on either side. There was a small pan up over the front end of the flues for preheating the sap as it came from the storage tank before it went into the evaporator by the steam underneath. At first the pan was made all together but after a year or two the flat pan up front was made separately for convenience in handling. This I believe was the first evaporator made that was completely reversible without turning any pans around.

As was the case with all evaporators up until that time, sirup was drawn at the back end near the chimney or stack. In 1905, a second Leader was introduced, called the Leader Special. In this pan, sirup or near sirup was drawn from either side of the front pan allowing more room for flues in the back pan. This greatly increased the heating surface and the boiling capacity.

Not being used to finishing the sirup over the fire, many completed the boiling in other flat bottom pans or sugaring off outfits at first, but as time went on sugarmakers became accustomed to drawing sirup in the evaporator with the Specials and their use increased.

Around 1930 the company was making about as many Specials as they were Regulars. The original Leader was called the Leader Regular. Today, it is very seldom that a Regular is ordered.

Following the Leader in this country came the Lightning Evaporator. This was first made in Dunham, Quebec, in 1885, again as a result of Canadian inventiveness. It was in 1906 that a branch factory was established in Richford, Vt. While no longer connected with the Canadian firm, the Lightning Evaporator Company is still active.

The Lightning pan is what is known as a raised flue evaporator. The flues are built up into the pan and the fire is forced to go up into them by the use of abutments in the arch. The raised flue construction permits a longer flue pan. Sirup is finished in the front pan. At first the partitions ran crossways and the sirup was drawn at the front end,but in recent years they have been put in lengthways so the sirup can be drawn at the back end of the sirup pan if desired, and the pan no longer has to be turned to reverse the circulation. At first the flues were 3-3/4 inches deep but later on were increased to 4-3/4 inches for added boiling surface.

Both the Lightning and the Leader offered a great deal more heating surface and boiling capacity than any other evaporator up until that time.

Another raised flue evaporator was made between 1885 and 1896 by the H. H. Budd Company of Enosburg Falls, Vt. I have no details on this one.

I believe the Vermont Evaporator was the next one to put in an appearance. Mr. Moroney, of the Vermont Evaporator Company, tells me that his company was started around 1900 in Rutland, Vt. The first one that I recall seeing consisted of a flue pan over the fire having about 2" drop flues following which was a flat sirup pan and then a deeper flue pan about two feet long. I believe about the same type of pans are used today except that the deep flue pan is much longer and the flues a little deeper. There are several variations available I understand. The Vermont Evaporator Company is now located at Ogdensburg, N. Y.

Next in line, I believe, was the Monarch evaporator. It was first made around 1910 I believe by True and Blanchard of Newport, Vermont, and later on by the Vermont Farm Machine Co. along with the Williams. The Monarch was a raised flue evaporator very similar to the Lightning except that the tops of the flues were round instead of flat and there weren't quite as many of them. With the use of a sub flue arrangement in the arch, they could be quickly cleaned at any time.

True and Blanchard also made a drop flue evaporator known as the Imperial. The flue pan was a drop flue type which tapered from nothing at the front end to 8" at the back end. With the closing of the Vermont Farm Machine Co. after World War I, a local roofing concern made both the Imperial and the Monarch for a few years sporadically, but they are now out of the picture completely.

In 1912, James Calder of Richford, Vt., who as an emigrant first worked for the Leader Company for several years, started his own business and made an evaporator called the Daylight. It so closely followed the pattern of the Leader Special that I will not go into further detail. It was made up until 1945.

In this same period, the Kier, Pope, and Daniels evaporators were made in Craftsbury, Greensboro, and Hardwick, respectively, all in Vermont. These pans presented a varied pattern of the ideas used up until that time and were made for several years and sold for the most part locally.

Around 1912, the Burlington Evaporator Company was organized by former employees of the Leader Company and later included George H. Soule of Fairfield, Vt., who was one of Vermont's largest producers at the time. This concern ended up as the George H. Soule Company of St. Albans about 1913. While in Burlington, two evaporators were made at first. One was the Maple Queen, which was so closely patterned after the Lightning that it had to be discontinued. The other was the Maple King, which was very similar to the Leader Special. Today, the King is very well known in the industry.

At some point along the way, the Sproul Company came out with the Cyclone evaporator in addition to the Keystone. The Cyclone was a deep flue pan at back, with a shallower flue pan in the middle and one sirup pan up front. It

had no way of changing circulation so was continually plagued with sugar sand. This company passed out of existence two or three years ago.

There have been other evaporators made by local plumbers, which have not branched out enough to become at all well known. Most of these have followed the patterns of those I have mentioned.

Today, I believe there are only five concerns left who are making evaporators and other sugar equipment. Listing them in the order in which they started, they would be: G. H. Grimm Company of Rutland, Vt.; The Leader Evaporator Company of Burlington, Vt.; the Lightning Evaporator Company of Richford, Vt.; The Vermont Evaporator Company of Ogdensburg, N. Y.; and the George H. Soule Company of St. Albans, Vt. With the exception of the Soule Company, all have been in business for more than 50 years.

Strangely enough in this whole period from 1888 when the first drop flue evaporator and in 1906 when the first raised flue type were introduced, there has been little deviation from these two styles of pans.

It is true, of course, that all of the companies have from time to time increased the heating surface and capacity of their evaporators by increasing the number, length and depth of the flues in their pans. Speed in boiling has been the chief target.

The use of steam has been made on numerous occasions where a steam boiler was available and being used for other purposes primarily. There have been one or two instances of steam generators being used. The cost of these put them out of the picture for most sugarmakers. It was found that a very light colored sirup could be produced but strong maple flavor was lacking. Through the proper use of steam, boiling can be very fast and scorch proof.

Thus there has been much material to present on the subject of old evaporators. When we start to talk about new ones, there is practically nothing to talk about other than a few improvements in construction that we have all made as time went on. We now have better methods of drawing off sirup than when we started and just recently we have begun to install automatic equipment on evaporators for drawing off the sirup in an effort to prevent part at least of the scorching, eliminate part of the sugar sand deposits, and help out greatly in the handling of evaporators.

Many sugarmakers are installing oil burners in their arches to give a steadier heat and eliminate the use of wood. These have proven out very satisfactory and the equipment manufacturers are cooperating by building the arches to the specifications required for the burners.

We now have installations where both the Automatic Drawoff and Oil burners are employed where the operation is almost entirely automatic. The operator only has to filter and can the sirup, keeping an occasional watch to make sure everything is all right in the pan.

There are no drastic changes contemplated in the style or makeup of our present evaporators that I know of--at least there are none that my company has in mind.

The equipment manufacturers are all thinking about anything that will improve their evaporators and are not so smug as to think that there is no chance for improvement.

We all have to keep in mind that equipment must be practical, we must keep the cost within the reach of the sugarmaker, and it must operate efficiently.

Our sales are continually decreasing as the sugar places are being cut off and our potential customers diminish. Hence we are struggling to stay in business and do not have too much money for research and experimentation even if we did have ideas to work on.

I believe that our greatest problem in the industry at present is to find some way to get the sap to the sugar house cheaper than we are at present. There has been little improvement in this problem from the very start.

We can in some instances cut the boiling costs by the cooperation of sugarmakers in taking their sap to one large evaporator rather than each individual doing his own boiling. The labor cost on a large evaporator per gallon of sirup can be cut to about 15¢. On a small unit it could be as high as $1.00 per gallon.

There are several methods of handling sirup from the evaporator being tried out. One that will work well with one perhaps wouldn't with the next. We are all willing to cooperate to the fullest extent with any sugarmaker who has ideas about an evaporator or any other equipment that he thinks will work out better for him. I am sorry that I cannot report on something entirely new and much better than we have been using. Tomorrow may bring what we are looking after.

AN ANALYSIS OF THE OPEN PAN EVAPORATOR

by
Eugene O. Strolle, Eastern Utilization Research Branch

Concurrent with the physical process of evaporation of water from maple sap in the open pan evaporator, chemical changes occur whereby color and flavor are developed. To understand the evaporative process, it is necessary to know the mechanism of heat transfer and mass movement. The evaporative capacity per square foot of heat transfer surface in each section and the fuel efficiency must be known.

Earlier investigations by chemists of the Maple Research Unit of ERRL have shown that length of time of boiling and sugar concentration are important factors in color and flavor development. Color is developed at a high rate at the higher sugar concentrations.

Since sugar concentration, residence time and evaporative rate vary in the different sections of the evaporator, an analysis of the evaporator requires that the function of each section in flavor and color development be studied.

To obtain data for analysis of the operation of the evaporator, studies were made in the field during the 1954 and 1955 maple sirup seasons. A small

oil-fired evaporator of conventional design was used. Samples were drawn simultaneously from fifteen points in the sirup pan and from six points in the sap pan four times during an hour's operation of the pan at equilibrium. Feed and product samples were also taken. Feed, product and oil consumption rates were measured. Sugar concentration and pH of the samples were determined. From these sugar concentrations and the measured volumetric holdup of the sections, calculations were made of pounds of sugar holdup, residence time, velocity, evaporative rate and overall heat transfer coefficient for each section.

Since color measurements on dilute maple sugar solutions cannot accurately be extrapolated to sirup density it was necessary to set up model experiments on a laboratory scale to duplicate the open pan conditions delineated by the field tests. Thus samples were prepared corresponding in sugar concentration to that obtaining in each section of the open pan, large enough to permit vacuum concentration, i.e., with no further color development, to sirup density for accurate color measurement. In their preparation the conditions of residence time and evaporative rate measured in the open pan field tests were duplicated.

The studies show that as sap moves through the evaporator the solids content increases, the velocity and evaporation rate decrease, and the residence time increases. As solids content rises viscosity increases, resulting in a decrease in velocity and consequent decrease in heat transfer coefficient. Very little color is developed in the sap pan; most is developed in the last two sections of the sirup pan.

The slowing down of the evaporation process occurs as the solids concentration increases, and with increasing solids concentration the rate of color development has been shown to increase. Therefore, to produce lighter sirup it is necessary to speed up the evaporation in the range of higher solids concentration. Speeding up the evaporation process must result from an increase in the overall heat transfer coefficient. Forced connection is required to improve the overall heat transfer coefficient. This is not practical in open pan evaporation but has been accomplished in a new steam heated tubular type evaporator developed at this Laboratory. By means of this evaporator, sirup is produced which is lighter than that made by processing the same sap in the conventional evaporator.

A NEW RAPID EVAPORATOR FOR MAKING HIGH GRADE MAPLE SIRUP

by
Roderick K. Eskew, Eastern Utilization Research Branch

The design of the open-pan evaporator generally used today for making maple sirup is the result of a great deal of practical experience. An experienced operator can produce with it a high percentage of desirable fancy sirup if good sap is available. Even with careful operation, however, some sap, particularly later in the season, produces darker, less desirable sirup. An evaporator, less difficult to control, which permits making fancy sirup throughout the season, is therefore desired.

To design such an evaporator, it was necessary to analyze the operation of the open-pan evaporator with regard to the development of color and flavor, change of sugar concentration and pH, and time of residence in various parts of the pan. This study has been completed 1/ and indicates that color begins to develop rapidly at about 20° Brix. Above this concentration the rate of color development continues to increase because of the longer residence time (due to the decrease in evaporation rate) and the high sugar content.

A rapid atmospheric evaporator (R.A.E.) was designed capable of concentrating the sap through this critical range so rapidly that very little color change takes place. In it, therefore, sirups of light color can be made from saps which yield dark sirups when processed in the open pan.

This type evaporator uses steam as a heat source. For this reason it is not considered as suitable for farm use, but rather for a cooperative or central plant. Sap would be partially concentrated in the open-pan evaporator to about 25° Brix and shipped to the central plant where the different lots would be blended, filtered to remove sugar sand, and then concentrated to sirup in the R.A.E.

In the new evaporator, blended and filtered partial concentrate is pumped at a controlled rate through a small-diameter preheater tube heated with steam at about 15 pounds pressure. Because of its high velocity in the preheater, the liquid is brought to its boiling point in a few seconds. From the preheater the hot liquid passes into a vaporizer, which is a tube or bundle of tubes, steam-jacketed as in the preheater, but of larger volume than the preheater tube, to accommodate the tremendous increase in volume occurring when the liquid vaporizes. The mixture of steam and sirup discharges from the vaporizer at high velocity into a centrifugal separator from which the steam is vented. The sirup is either drawn into a container and filtered and packaged without delay, or it is held hot in a jacketed chamber to intensify flavor.

The principles involved in the design of the R.A.E. are described in terms of the simple heat flow equation $Q = UA \triangle T$. The operation of the R.A.E. is compared with the operation of the open-pan evaporator at a sirup production rate of about 2 gallons per hour. The heat requirement (Q) is the same in both cases since the amount of water to be evaporated is the same. It is shown that, in spite of a much higher temperature difference between heat source and boiling liquid ($\triangle T$) in the open pan than in the R.A.E., the R.A.E. requires only about 3/10 the heat transfer area of the open pan. This is due to the much higher heat transfer coefficient (U) in the R.A.E., which is about 75 times greater than that of the open pan. Heat transfer coefficients of boiling liquids are increased when high rates of circulation across the heat transfer surfaces are obtained. The high velocities obtained in the R.A.E. (more than 500 ft./min.) as compared to the 0.1 ft./min. in the open pan are responsible for the 75-fold increase in the heat transfer coefficient (U).

In the pilot plant R.A.E. sirup having a color index of 0.50 (fancy) has been produced from sap which yielded sirup of color index 0.83 when evaporated in the conventional open pan.

1/ An Analysis of the Open-Pan Maple-Sirup Evaporator

A larger R.A.E. has been designed, capable of producing 25 gallons per hour of sirup. Construction drawings of this unit may be obtained from ERRL.

SOME CONSIDERATIONS ON RESEARCH FOR THE IMPROVEMENT OF THE ANALYSIS OF MAPLE PRODUCTS

by
Marcel Jean, Laval University
Quebec, Canada

The Quebec government began field inspection of maple products about six years ago. This was undertaken to help the industry, which was then annoyed by a few cases of gross adulteration. Through the use of conductivity tests most instances of gross adulteration have been eliminated. Unfortunately this has not prevented adulteration where only a small amount of the adulterant is added. The detection of adulteration where only small amounts of cane sugar are added to pure sirup is hampered through the lack of precise methods of analysis. It is felt that some farmers have become acquainted with this situation and so dare to adulterate their product. While it is possible that this condition could get out of hand it is fortunate that the inherent honesty of people will prevent this from becoming a widespread practice.

Even so, it becomes necessary that measures be taken to establish efficient methods of analysis that will detect small amounts of adulterants. We at Laval University have been engaged in a search for such methods. From the beginning such a study has suffered because of the lack of information concerning the concentration and the distribution of the various mineral constituents of maple sirup. It had never been satisfactorily demonstrated whether or not the analysis of sirups for potassium or phosphorus might provide the answer to the problem. To establish methods for the detection of adulteration based upon the analysis of K_2O and P_2O_5 it becomes necessary to obtain data showing the variation in the concentration of these elements in sirups produced at different times during the sap season and in different years. This, in turn, would require a large number of authentic maple sirup samples, which are not easy to obtain. Because of this we decided to conduct the experimental work from sap collected by us from a single tree on the campus.

Samples of sap were collected each day during the past three sap seasons and analyzed for sugar, potassium and phosphorus. On the first day of sap flow in 1954 sap equivalent to 30.8 grams of sugar contained 107 p.p.m. of K_2O and and 3.1 p.p.m. of P_2O_5. The second day produced a quantity of sap yielding 19.6 grams of sugar which contained 105 p.p.m. of K_2O and 2 p.p.m. of P_2O_5. This demonstrates the variation of these two elements in sap within a given season. As the season progressed there appeared to be a slight increase in the K_2O and a definite increase in the P_2O_5.

In the 1955 experiments variations in the K_2O and P_2O_5 contents of the sap were again apparent but with a lesser increase in K_2O. The P_2O_5, however, showed about the same marked increase as was observed in the 1954 study.

In the year 1956, P_2O_5 again showed an increase toward the end of the season; this was not the case with the potassium since highest values for K_2O were obtained at the middle of the season.

From these observations, information can be obtained which is useful when establishing values for pure products. For instance, the maximum values for P_2O_5 will likely be obtained from late season samples. As for the minimum and maximum K_2O contents, they will be better appreciated by the analysis of every day sirups from a few different sugar bushes.

Over the three years, the K_2O contents of maple sap were found to vary from 105 to 188 p.p.m. The variations of P_2O_5 (1.2 to 17.5 p.p.m.) were so great that the determination of this element appears useless as a means of detection of adulteration.

Aside from this work on the variation of K_2O and P_2O_5 contents, efforts have been made in order to appreciate the effectiveness of K_2O and P_2O_5 analyses in detecting adulteration made by the addition of white sugar to sap. The samples necessary for this work were prepared by Mr. G. Vallières.

Sap collected on a particular day had its sugar content determined and was divided into two parts, A and B. Part A was boiled to sirup "as is." To Part B was added white sugar in various amounts representing 15, 25, 35, 50 and 100 parts to each 100 parts of the maple sugar already present in the sap. The samples of adulterated sap and pure sap were boiled down to standard density sirup.

The adulterated sap-sirups were then analyzed for K_2O and P_2O_5 and the amounts of K_2O and P_2O_5 that should be present in the adulterated samples were calculated based upon the analysis of the unadulterated sap sirup (Part A).

In the case of K_2O, the amounts found in the diluted (adulterated) sirups were in close agreement with the calculated values. This was not the case with the P_2O_5 values. For some reason, the P_2O_5 values did not diminish with adulteration. This shows again the weakness of P_2O_5 analysis as a check for purity of maple products.

K_2O and P_2O_5 determinations are not the only ones that have been made on pure and sap-adulterated sirups. In fact, we have initiated a study of the various different official methods of analysis a few years ago, and we hope to be able to say within a few years which are the most effective.

Finally, in addition to our studies on K_2O, P_2O_5 and official methods, work is being done with hope to find a more efficient test. In order to reach that goal, we are continuing the use of pure and sap-adulterated sirups. To a set of such samples is applied simultaneously any method. Up to now, we have found that no improvement on the present situation can be expected from organic acids or sugar determinations.

Thus, at the present time, we have not succeeded in improving the situation through the development of a satisfactory chemical method for the detection of adulteration of maple sirup. How close we are to success, no one knows. But, in my mind, the departure from the old method of using random samples and the decision of preparing pure and sap-adulterated sirups at the sugar bush place us in the best position to arrive at some improvement which is so badly needed.

I wish to acknowledge and thank the Quebec Department of Agriculture and especially Mr. Jacques Tardif and Mr. G. Vallières for their help in securing the material and apparatus necessary for this work.

SOME OBSERVATIONS ON FACTORS AFFECTING THE PRODUCTION OF MAPLE SAP

by
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Burlington, Vermont

Much can be done to aid the maple industry through mechanization and improvement in equipment. Yet there are limits to technological advances in any industry dependent for its raw material in a living plant or animal. When dealing with living things there is another approach: (a) improvement of the plants or animals by selection or breeding, and (b) improvement in our understanding of these plants and animals.

Since the efficiency of a maple operation is closely tied in with the performance of the trees themselves, the Botany Department of the University of Vermont in 1943 outlined a broad program of research involving anatomical, physiological, ecological, genetical and pathological aspects of the maple tree. Two areas of special interest and immediate importance were selected for intensive study.

1. Determining the range of variability in sap quality and yield in natural stands of maple.

2. The problem of the sap flow mechanism.

Recently (1956), the results of the twelve-year study on range of variability in the sugar content of maple sap appeared in a bulletin of the Vermont Agricultural Experiment Station and will be summarized in this discussion.

The study revealed that maples vary widely in sugar content of the sap. Individual maples vary in sugar content of sap from season to season and within the limits of a single season. In spite of the variations maple trees generally maintain their positions in sugar content relative to their neighbors throughout the season and from year to year.

Groups of maple trees (sugar bushes) also show wide variation in sugar percentage. Sugar bushes vary from season to season and within the season. When compared to one another sugar bushes are consistent in performance within the season and year after year.

Studies on the volume yield are incomplete but it can be said that, even though the pattern is not as uniform as in the case of sugar content, high and low producers can be recognized within a season and from season to season.

Studies on the mechanism of sap flow indicate that:

1. Gas expansion does not account for the pressure developed during a run.

2. There is no special substance in sap responsible for sap flow.

3. Sucrose is not necessary.

4. The mechanism involves living cells.

5. Stems, raised to a constant temperature and held there, flow for a time and then begin to absorb.

Another problem has been investigated by our physiology group. Sap flows after a rise in temperature. Is this temperature rise just a change which sets off the flow or is there a direct relationship between amount of temperature change and amount of sap produced? Is the temperature on the day of flow the important one or do previous temperature conditions influence rate of flow? To answer these questions data were collected over a four-year period. Continuous temperature records of air, soil, bark, wood and twigs of producing trees were made. Continuous sap flow rates and amounts were measured for the same years.

Statistical analysis of the data revealed air, bark, wood and soil temperature were not related to flow and twig temperature was selected for use in the correlation study.

The statistical analysis indicated that the number of hours below freezing in the previous twenty-four hours made the greatest contribution, while the actual temperature rise on day of flow contributed little to the flow. The greater influence of temperature on the previous day suggests a conditioning effect, while the small contribution made by the temperature rise suggests a "triggering" effect and indicates why good runs of sap may occur with a temperature rise only one or two degrees above freezing.

It is hoped that our research on sap and sap production will be of value in several ways:

1. In making recommendations for improving existing maple stands and in establishing new ones.

2. In solving some basic problems of hardwood tree physiology.

3. In designing new equipment or modifying equipment already in use to take full advantage of the tree's productivity.

4. In freeing the producer to a greater degree from dependence on the vagaries of the weather.

THE PRODUCTION OF HIGH QUALITY SAP AND SIRUP

by
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East Lansing, Michigan

In order to produce high quality maple sap we must first of all have high quality healthy trees capable of flowing the maximum volume of sweet water. A sugar bush should be regulated by good timber management practices. A sugar bush should not be used for grazing as this destroys the young growth needed to replace overmature maples that are ready for harvesting as sawlogs. Weed trees should be removed and thick young stands thinned to encourage the formation of healthy, large-crowned maples.

The manner of tapping affects the health of the tree and, consequently, the flow of sap. Tapping all quadrants of the tree will pay dividends. Over a three-year period, from 168 tap holes at Michigan State University's sugar bush there was no significant difference in sweet water yields due to the position of the tap hole. Concentrating tapholes in one quadrantor area of the tree produces in a few years a large amount of damaged tissue where fungi, molds, and yeasts may grow more profusely. The taphole should be in thick healthy sapwood, and to assure this type of wood we must rotate the tapping to all quadrants of the tree. Rotating is the best way to secure high quality sweet water in large volume year in and year out.

Maple producers have long put a premium on maple sirup from first run sap. Cold weather in early part of the season is less favorable to bacteria, mold, and yeast development and this results in higher quality sirup. In Michigan, to help producers benefit from early runs, a maplesap weather forecasting service has been provided by the U. S. Weather Bureau and the Forestry Department of Michigan State University. Charts of sap yield and weather data illustrate the great variation in the flow of sweet water during a season. In 1953, the largest yield of the season was obtained on February 20, with 34 percent of the total yield occurring in the month of February. The second and third largest flows of the season occurred 21 and 30 days after the tap holes were drilled. If drying-out of the tap hole is the cause of reduced flow and lower quality sap these tap holes had sufficient time to dry out and reduce the yield. Is this not a tipoff that drying-out is not the cause of low quality maple sap and tap hole stoppage?

Again in 1954, 35 percent of the total maple sap flow in central Michigan occurred during February. The largest single day flows occurred 32 and 33 days after the trees had been tapped.

In 1955 early tapping produced 16 percent of the total volume of maple sap. Therefore it is evident that a significant amount of sap can be obtained by early tapping. This sap gathered during the colder early weather produced fancy grade sirup.

During the 1953, 1954 and 1955 seasons the type of spile, collection container, or depth of tapping over 4 inches had no effect on yield and quality of maple sap. Thus we might conclude that the quality of the sap and maple sap yield are tied up with activity within the tap hole.

To test if the activity within the tap hole is responsible for stoppage of sap flow, in 1955 we tapped an additional fifty trees by the "aseptic" tapping method used at the Eastern Laboratory. Each tree held one bucket or bag and one "aseptic" container. Tapping was done on five different dates--January 10, January 25, February 10, February 25 and March 10. The aseptic tapping showed for the January 10 tapping an increase in yield of 74.9 percent over the normal tapping. For the January 25 tapping an increase of 45.6 percent yield was obtained by aseptic tapping, and for the February 10 tapping a 40.4 percent increase was observed. This difference between aseptic and non-aseptic tapping is statistically highly significant. Therefore we know that the reduction of maple sap flow must be due to microorganisms active in the tap hole.

Dr. Costilow and Jack Sheneman tested this theory of microorganisms and will report on it in their paper.

The results of clean, sanitary tapping techniques were reflected in the high quality sirup produced from the daily sap yields during the 1953, 1954, 1955 and 1956 seasons. The 1956 season at East Lansing started February 14, and continued cool. Sap flowed many days only because the sun warmed the south side of the trees. The heaviest flow of the season occurred on April 1, 45 days after the first trees were tapped, and continued to April 15. In a normal season, similar to 1953, 1954 and 1955 the sap flows ended by April 1 or shortly thereafter. In 1956, "fancy" or "light amber" grade sirup was produced as late as April 4 and medium and dark amber sirup of good flavor right to April 15. Therefore it pays to start tapping early and conduct all operations in as sanitary manner as possible.

THE MICROBIAL CONTAMINATION OF THE TAP HOLE

by
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Observations and investigations on premature stoppage of sap flow by Drs. J. Naghski and C. O. Willits of the Eastern Regional Laboratory prompted further studies on the microbial contamination of the tap hole as related to premature decline in yield and stoppage of sap flow and also to determine how the date of tapping influences the microbial contamination and the yield of sap.

In 1955 fifty sugar maple trees which had not been tapped previously were selected for this study. Ten of these trees were tapped on each of five dates at approximately two-week intervals beginning January 10. These dates were chosen so that the first three dates would fall before the normal tapping period, the fourth date during the normal tapping time, and the last date after the normal tapping period. Each tree was tapped twice on the same quadrant using the normal commercial tapping technique for one tap hole and an "aseptic" technique for the other. The word "aseptic: is used in quotes because it is very difficult to maintain absolute asepsis throughout the season under conditions found in the sugar bush.

The yield of sap from each of these tap holes was measured to the nearest tenth of a pound on each day that a sap flow occurred. Also, at regular intervals during the season, the sap was aseptically sampled for the determination of types and numbers of microorganisms present in the sap. The organisms which were isolated were preserved for further studies.

The total yield of sap from all "aseptic" tapping was about 40 percent greater than the total yield of the regular tap holes. The greatest difference in yield of "aseptic" as compared to regular tapping occurred in that group of trees tapped earliest (January 10). The "aseptic" tappings produced about 1000 pounds more or about 67 percent more sap than the regular tappings of the same ten trees. This difference decreased progressively for the groups of trees tapped later in the season until less than 3 percent difference was recorded for the last tapped group which was tapped after the start of the season.

A correlation can be made between the differences in yield and the amount of microbial contamination. In instances where high microbial populations were found in the sap from the tap holes made in regular manner at a considerably earlier time than in the sap from those tapped in an "aseptic" manner, very great differences in yield were observed with the "aseptic" tap hole yielding two to three times as much sap as the regular tap hole. However, when microbial activity was about the same in the sap from both tap holes on a tree, the yield was also very nearly the same.

In 1956, two groups of 15 trees each were tapped with three tap holes per tree in the following manner: one hole tapped "aseptically" and then inoculated with microorganisms, a second hole tapped "aseptically" only, and the third hole tapped according to regular tapping procedure. The results for sap yields obtained in 1956 verify the results of the 1955 season in that the "aseptic" holes out-produced the normal tap holes. The inoculated tap holes produced less sap than the normal tap holes. The "aseptic" tap holes produced about 14 percent more sap than the normal and about 62 percent more than the inoculated tap hole.

The deliberately contaminated tap holes were inoculated with species of bacteria, yeasts, and molds, or combinations of these groups. The results showed that every organism used in the inoculations was capable of causing a decrease in sap yield and premature stoppage of sap flow. This indicates that premature stoppage of sap flow is non-specific in regard to microbiological etiology and depends only upon the ability of the microorganism to grow in the environment of the tap hole.

For studies of the microbiological flora of maple sap, 1273 cultures of organisms have been isolated. About two-thirds of the organisms are psychrophiles or those organisms capable of growing at cold temperatures. Bacteria and yeasts were fairly equal in frequency of isolation. Of the bacterial species, the largest number belong to the genus Pseudomonas. Other bacterial genera are: Flavobacterium, Achromobacter, Micrococcus, Bacillus and Sarcina. Two genera of yeasts have been identified as Rhodotorula and Trichosporon. Nine genera of molds have been identified.

Experiments have been initiated in an attempt to determine methods of chemical treatment which might be of value in the control of tap hole infection. The treatments attempted during the 1956 season were inconclusive because of the unusual season.

SUBJECTIVE TESTING OF TOBACCOS TREATED WITH HIGH-FLAVORED MAPLE

by
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Raleigh, North Carolina

A large market for maple--consuming as much as 9,000,000 lbs. of maple sugar annually--has disappeared. This market was for maple used by the tobacco industry in the manufacture of cigarettes. Under a research contract with the Eastern Utilization Research Branch, the North Carolina Agricultural Experiment Station is conducting a program of adding high-flavored maple to tobaccos and evaluating cigarettes made from these treated tobaccos by means of taste panels.

The composition of any one cigarette on the market today is a closely guarded trade secret of its manufacturer. We can, however, describe generally a "typical" cigarette with the understanding that no single brand may be thus described.

Bright leaf (flue-cured) tobacco	60%
Burley tobacco	30%
Turkish tobacco	5%
Maryland tobacco	2%
Other tobaccos and blending agents	3%

The bright leaf tobacco requires an aging of approximately two years before use. Burley tobacco, air cured and dark brown in color, must be "cased" before using. "Casing" is a process wherein the leaves are dipped in a sugar solution, dried and then shredded for blending.

After the dried and shredded tobaccos have been blended they are usually sprayed with a top dressing containing such materials as licorice, rum and oil of balsam which do not contribute any of their own flavors as such but do enhance the natural tobacco flavor.

Flue-cured tobacco when properly blended makes a satisfactory cigarette by itself. English-type cigarettes are usually 100% flue-cured tobacco.

In the proposed research program we are beginning with maple-flavored flue-cured tobaccos and will progress into fully blended cigarettes as the project develops.

The selection of a panel is accomplished by asking prospective judges to identify the odd cigarette in a set of 3, two of which are alike and one different. The judges are asked to do this in repeated trials and the ones with a relatively large percentage of correct selections are accepted for the taste panel. For example, the judge who is not discriminating but just guessing will get 1/3 of the sets correct on the average. If each judge tried 6 sets he has one chance in three of getting 3 or more out of 6 correct. But he has only one chance in 10 of getting 4 or more out of 6 correct. Then if we limit our selection to those who get at least 4 out of 6 correct, we will run a risk of only one in 10 of choosing a judge who is not discriminating.

Forty-two treatments have been selected and prepared for the first screenings by a panel. Seven samples of maple-cane mixtures at each of 3 rates of addition (1, 3 and 9 lbs. of sugar per 100 lbs. tobacco), and two times of application (before aging and after aging) make up these 42 combinations. The information gathered in the initial tests will determine which combinations should be carried through to a fully blended cigarette.

THE COLOR AND FLAVOR OF MAPLE SIRUP
CHEMICAL FACTORS

by
J. C. Underwood, Eastern Utilization Research Branch

Since this is my first maple conference, when I was asked to make this report on the chemical factors effecting color and flavor of maple sirup, I first read the abstracts of the earlier maple conferences so that our story this time would coordinate with past work. In the "Report of Proceedings - Second Conference on Maple Products" the following conclusion was given to Dr. Porter's talk: "We, the scientists, are still baffled as to the identity of the flavor constituents of maple. However, we are gaining knowledge of the mechanism of the formation of these materials, which we can and already have applied to maple products." In 1956, three years later, we are still baffled as to the chemical identity of maple flavor and color, but we have learned still more of their formation in sirup since 1953 and I am going to tell you about some of this work.

Those of you who have attended the earlier conferences here may remember some of the background remarks I am about to make. They are necessary to make our story clear and complete. The characteristic flavor and color of maple sirup are developed during the concentration of maple sap by atmospheric boiling. An almost flavorless and colorless sirup has been produced by low-temperature vacuum evaporation of sap. Further by freeze-drying it is possible to make a completely colorless and flavorless (maple flavor that is) product. Therefore we can say that the color and flavor of the sirup are formed from constituents of the sap by the atmospheric boiling process.

The maple sap as it comes from the tree contains about 2% sugar solids, of which sucrose (cane sugar) constitutes more than 98%. Reducing sugars, if the sap remains sterile, are absent. However, fermentation of the sap by contaminating microorganisms will cause splitting (inversion we chemists call it) of the sucrose to varying amounts of reducing sugars. Work here as well as that reported by Edson, Jones, and Carpenter at the Vermont Agricultural Experiment Station has shown that the growth of microorganisms in sap often results in dark colored sirup. Hayward and Pederson at the New York State Experiment Station have studied the effect on the sirup of adding acids and alkalies to maple sap. During these studies and also in work here it was found that the sap passes through an alkaline stage during its evaporation. This suggested the possibility that alkaline degradation of the reducing sugars in the sap might be a part of the mechanism of color and flavor development in maple sirup. The breakdown of such reducing sugars as are in maple sap has been studied by numerous people. Such 3-carbon carbonyl compounds as acetol, reductone, glyceraldehyde, dihydroxyacetone have been isolated from alkaline glucose solutions and such natural products as milk.

As these compounds are steam distillable, it seemed possible that they could be isolated from maple sirup by this procedure. A sample of fancy maple sirup yielded 5 p.p.m. of carbonyl compounds. This is a very small quantity as the 2% sugar in the sap represents 20,000 p.p.m. Because these carbonyl compounds are reactive as well as being present in small amounts, the scientist uses a trick method of studying them. I suppose this method is like that used to prevent the loss of small items such as keys by placing them on a large ring

or tying them to a stick. We tied down the carbonyl compounds by hooking them to another chemical compound. The chemist calls this forming a derivative of a compound. With the carbonyl compounds the colored 2,4-dinitrophenylhydrazine derivative was formed. This gave us a mixture of colored compounds several hundred p.p.m. in weight.

This mixture of carbonyl compound derivatives was passed through a chromatographic column and separated into 8 fractions. I will not say much about this means of separation as it will be demonstrated in the laboratory later this afternoon. For this report we will just say that it is a modern way of separating mixtures of compounds into pure fractions.

Only three of the fractions gave us enough material for further identification tests. These were compared in several ways to the 2,4-dinitrophenylhydrazine derivatives of known carbonyl compounds such as acetol, reductone and glyceraldehyde.

A color reaction of the 2,4-dinitrophenylhydrazine derivatives with alkaline ethanol showed that fractions 5 and 8 were the same as acetol, reductone and glyceraldehyde. The melting point of the 2,4-DNPH's was the same as fraction 8, indicating that this fraction may be one of these 3-carbon carbonyls related to glucose degradation.

Another way in which chemical compounds may be identified is the comparison of light absorption curves. When a chemical compound dissolved in a solvent is placed in a special instrument in which different wave-lengths of light are passed through the solution, the amount of the different wave lengths of light absorbed by the compound can be measured and recorded as a curve on graph paper. These curves for known and unknown compounds can be compared. Again fractions 5 and 8 resembled the 3-carbon carbonyls such as acetol, glyceraldehyde, or reductone.

The demonstration of the presence of these triose compounds (3-carbon carbonyls) in maple sirup suggests that they are intermediates in color and flavor development.

THE COLOR AND FLAVOR OF MAPLE SIRUP
MICROBIOLOGICAL FACTORS

by
Lawrence L. Reed, Eastern Utilization Research Branch

Maple sirup produced early in the maple season is generally light amber in color and delicately flavored, but sirup produced in the later part of the season usually acquires a dark coloration and a stronger flavor which may not be entirely due to maple. This change in color and flavor has been associated with the growth of microorganisms in the sap from which the sirup is made. To better understand these changes, sterile sap was fermented with various microorganisms before being made into sirup.

The microorganisms were isolated from the microflora of maple sap and consisted of four species of bacteria and one yeast. The bacteria are designated as

Pseudomonas-25, Pseudomonas-11, Flavobacterium-583, and Bacterium-587. Eight fermentations of identically replicated sterile sap were carried out with five of these fermentations produced by individual species of microorganisms and three by combinations of bacteria and the yeast. The inoculated sap was incubated in the cold at 33°-35°F. and samples of sap were removed from each fermentation at 3, 6, and 10 days for concentrating to sirup. After determining the microbial numbers for each fermentation period, the sap was reduced to sirup in a manner simulating the evaporating conditions found in the field. The following determinations were made on the resulting sirups: (1) percent invert sugar, (2) color indices, and (3) flavor evaluations. The results of these analyses were compared to those of the control sirup made from the non-fermented sap.

The results of the counts of microbial numbers in the fermenting sap showed an increased growth for all of the microorganisms. This indicates that maple sap is a good growth medium for these organisms. The yeast and the two species of Pseudomonas showed a decided increased growth over the original inoculum. The Flavobacterium and Bacterium species showed a definite increase in numbers,but the growth was not as rapid and dramatic as that of the Pseudomonas.

Analyses of the sirups for percent invert sugar showed that there was no significant change over the control in those sirups from sap fermented by both species of Pseudomonas and the species of Bacterium. There was only a slight increase of invert sugar in the sirups from the Flavobacterium fermentations. In contrast to these results, the sirups from the yeast fermentations showed a considerable increase in invert sugar over the control sirup and the sirup from the 10 day fermentation had a total invert sugar content of nearly 5.5%, which is undesirable. In the sirups from the fermentations by combinations of bacteria and yeast there was a significant increase in the percent of invert sugar over the control.

The results of the color indices determinations showed that with one exception there was a progressive increase in color until the sirups from the 10 day sap fermentations were a dark amber color. The exception was the fermentation by the Bacterium species where the sirups exhibited only a slight increase in color beyond the color of the control sirup. The fermentation of the sap by both species of Pseudomonas, the yeast, and the combination of Pseudomonas and yeast produced the darkest sirups.

In flavor evaluations, two flavors were detected: a full-bodied maple flavor and an acrid flavor which has been termed caramel. Flavor levels were indicated by numerical values with 0 being no discernible flavor and 4 being the greatest detectable level. Sirups produced from all the fermentations showed a distinctive maple flavor of an intensity level of 1 or more.

Fermentation of sap by Pseudomonas-25 showed the greatest effect on maple flavor with progressively higher intensities of flavor being found with increase in time of fermentation. No caramel flavor was detected even in the dark sirup from the 10-day fermentation. This then was a unique sirup in that it was dark, had no increase in invert sugar, had no detectable caramel flavor,but did have an intensification of the maple flavor. Commercial sirups of similar grade usually have a high invert sugar content and a strong caramel flavor.

Sirups from the yeast fermentation showed no increase in maple flavor but did exhibit a strong caramel flavor. Thus, the dark sirup of the yeast fermented sap corresponds to the dark commercial sirups having high invert sugar content and strong caramel flavor.

The other bacterial fermentations caused various effects on the flavor of the sirups. Pseudomonas-11 caused no increase in maple flavor and did cause some caramel flavor in the sirup from the 10-day fermentation. Bacterium-587 might be termed inert since it caused no detectable change in the flavor of the sirup and had very little effect upon the other analyzed characteristics. The sirups from the Flavobacterium-503 fermentation attained a maple flavor level of 2 and also a caramel level of 2.

The fermentations of sap by the combinations of bacteria and the yeast produced sirups which either had an increase in caramel flavor or in the case of the Bacterium-587 and yeast fermentation an off-flavor was produced.

Through controlled microbial fermentations of maple sap it has been shown that microbial activity in the sap has a marked effect upon the flavor and color of maple sirup. The development of maple and caramel flavors may be enhanced or caused by the fermentation of sap by specific microorganisms. There is a marked correlation between caramel flavor and the amount of free reducing sugar (invert sugar) in the sirup. This is particularly pronounced where yeast fermentations are involved.

THE PROCESSING OF MAPLE SAP TO SIRUP

by
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This paper will be a brief resume of some of the problems of sirup processing to which we have been giving attention but which have not been the subject of previous talks at this conference. It deals with the practical aspects of the different problems encountered in maple sirup processing. One of the most important of these is that of sap collection.

This part of sirup making is unquestionably the most expensive and laborious, as well as the most disagreeable of all the operations involved and it is certainly one of the most antiquated phases of maple sirup production. Robert Bell in his "Cost and Returns in Producing and Marketing Maple Products," Dept. Agr. Econ., Cornell University, 1956, has shown that 43% of all of the labor or sirup making is used in gathering sap. He also showed that the boiling of sap is a close second in labor requirement.

Studies to reduce these costly labor requirements of sap collection are being conducted by our staff. Plastic pipe lines may offer a solution. These can be used in one of four ways: (1) to run the sap from the one or more tap holes on the same tree to a common receiver, (2) to transport sap from the orchard to the sugar house, (3) to transport sap from multiple sap dumping stations throughout the orchard to the sugar house, and (4) to transport the sap directly from the tap hole to the sugar house. Before plastic pipe can be recommended for any of these uses, a number of questions must be answered:

Can the pipe lines be kept sterile? Can the formation of sap ice plugs, especially when lines have been laid on snow, be prevented? Will any substance from the tubing be dissolved by the sap? If so, are these substances harmful or will they impart an "off" flavor? Some of the ways that we are approaching these problems are displayed in the exhibits of this conference.

Another means of reducing the labor of sap collection is the use of ten- to twelve-gallon sap buckets which need emptying only every week or two. Such a system has been in effect for several years in western New York. This holding of the sap in open containers for long periods of time is contrary to all good sirup producing practices and we could not recommend it. Recently in our work on the effect of controlled fermentation on flavor (see Dr. Reed's report) we used galvanized cans similar to those that had been used for sap collecting in western New York. Even though we were using organisms which were known to grow well at temperatures of 32° to 40°F. we were astonished to find that at the end of a week the bacterial count of this sap had become almost zero. An analysis of the sap showed that minute amounts of the zinc (from the galvanized coating of the cans) was dissolved by the sap and that perhaps this dissolved zinc was preventing the microorganisms from growing. This phenomenon of sterilization of solutions by minute amounts of dissolved metals (silver, copper and zinc) is not new and is called oligodynamic effect of metals. In fact, it has been known for hundreds of years. Much attention was given to this effect during the twenties and was the subject of many scientific papers and books. However, like other things of a controversial nature, interest in this field has largely died out.

Because the oligodynamic effect of zinc which we observed was so startling, we immediately set up experiments which we hoped would help to clarify the situation. The results which I am reporting must be taken as preliminary and much more data will have to be obtained before recommendations, if any, can be made.

For these studies we used two types of cans (made by different manufacturers) having different galvanized (zinc alloy) surfaces. These cans were designated A and B. Also in the experiment was a can of type A which had been used, so that the galvanized surface had become coated with a protective oxide film. Also included was a used type A can from which the protective film had been removed. Sap containing an inoculum of mixed cultures of microorganisms normal to maple sap was added to each of the cans and to a glass bottle to serve as a control. All were stored at 33° to 35°F. Samples were removed periodically to follow the change in the bacterial count of the sap as well as the amount of zinc dissolved. The results are given in Table I.

TABLE I

CORRELATION BETWEEN GROWTH OF FERMENTING ORGANISMS AND THE AMOUNT OF ZINC DISSOLVED

	0 DA.	2 DA.	3 DA.	6 DA.	8 DA.
CAN A NEW	3,000*	1,000*	200*	31*	0
	--	--	--	--	--
CAN A USED	3,000*	--	55,000*	7,400,000*	13,000,000*
	0 p.p.m.	2.7 p.p.m.	2 p.p.m.	6.1 p.p.m.	1.8 p.p.m.
CAN A CLEANED	3,000*	2,000*	1,200*	200*	70*
	0 p.p.m.	11.3 p.p.m.	11.3 p.p.m.	16.2 p.p.m.	20.9 p.p.m.
CAN B NEW	3,000*	40,000*	30,000*	20,000*	9,000*
	0 p.p.m.	5.4 p.p.m.	6.7 p.p.m.	10.9 p.p.m.	9.7 p.p.m.
GLASS	3,000*	76,000*	64,000*	9,000,000*	

* NUMBER OF ORGANISMS PER ML.
p.p.m. PARTS PER MILLION OF ZINC

This table indicates that (1) zinc can be dissolved by the sap when the galvanized surface is exposed, and (2) there is an apparent correlation between the amount of zinc dissolved and the growth rate of the bacteria.

When this sap was converted to sirup, it was observed that the amount of zinc in the sirup was of about the same concentration, 20 p.p.m., as it was in the sap even though the sap had been concentrated forty times. This is no doubt accounted for by the precipitation of a large part of the zinc as organic salts as the sap is being concentrated. The results are given in Table II.

TABLE II

ZINC IN FINISHED SIRUP

SOURCE	UNFILTERED	FILTERED
CONTROL (GLASS)	0 p.p.m.	0 p.p.m.
CAN A USED	0	0
CAN A CLEANED	21	21
CAN B NEW	9	9

Again let me remind you that these results are preliminary and that more work is to be done before we can recommend the use of large-sized galvanized sap buckets for infrequent sap collections. However, it may be the explanation of the apparent success of the use of these large sap buckets in western New York.

We have already shown how an automatic oil burner can be used to reduce labor. This is described in our circular AIC-358, "Oil Firing for the Maple Sirup Evaporator," by G. W. M. Phillips and Richard Homiller. An oil burner eliminates entirely the need of a fireman, and the cost of the oil is comparable to the cost of wood fuel, except that no farm labor is required to procure the oil fuel.

In the past the drawing of sirup at the instant it reached standard density has required the services of one person almost full time. Through the use of an automatic draw off this person can be largely eliminated, with a further saving in labor. The Canadians have had such a device on the market for the past three years. We have a working exhibit of an automatic sirup draw off in the laboratory which employs inexpensive, commercially available, American-made parts. The automatic device consists of a solenoid valve, which can be obtained to operate on either 6V, DC or 110V, AC, and a thermoswitch to control the opening and closing of the valve. The assembly should cost less than $50.00. The thermoswitch is self-contained, requiring no auxiliary relays or cutouts. A thermometer is required to establish the setting of the thermoswitch so that it will open the circuit when the temperature of the boiling sirup reaches 7° above the temperature of boiling water.

Another time and labor consuming operation is that of filtration. One of the better methods used commercially is that of centrifugation. This appeared to be out of the realm of application on the farm. However, it is quite possible that cream separators can be adapted to this use after certain modifications have been made. We have been conducting studies to determine whether or not modifications of commercially available home cream separators will make them suitable for the clarification of maple sirup. These studies show great promise, but we will need to conduct further field studies before we can make any recommendations.

Everyone is aware of the problem of keeping the sirup pan free of scale. Evaporators have been made with reverse flow features to eliminate the scale, but without complete success. Recently it came to our attention that the Grasselli Chemical Department of E. I. duPont had developed a new milk stone remover called sulfamic acid, HSO_3NH_2. We found that when this crystalline material was made up in a 6% solution (1 cupful per gallon of water), it loosened the scale, regardless of its condition, after a short soaking period. This was done without harm to the evaporator, providing the evaporator was tin plated. Recently other companies who are handling sulfamic acid have been adding modifiers to it so that it will have less action on zinc and iron surfaces. When we have tested these, the information will be made available to you through the sirup equipment supply houses and the extension service.